

Digital Lunar Exploration Sites Unreal Simulation Tool (DUST)

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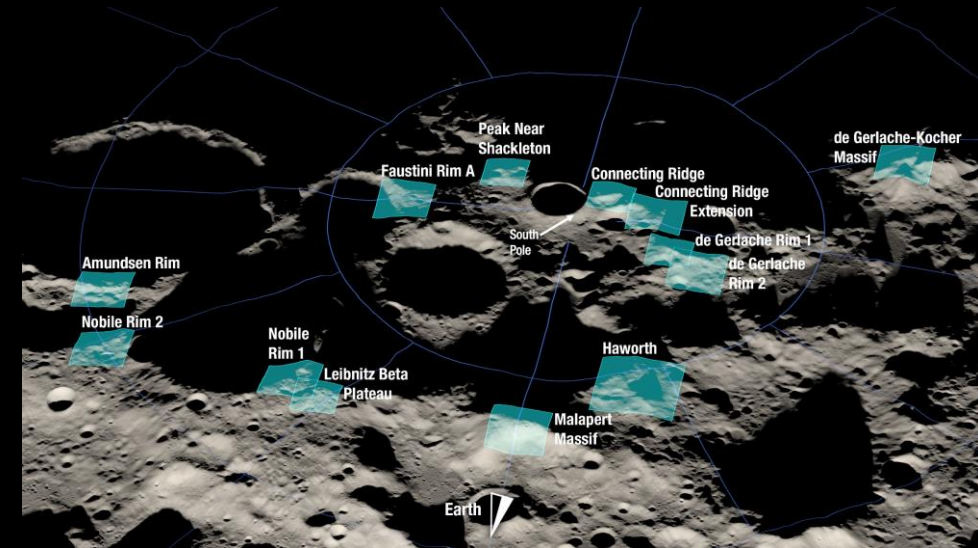
Presentation Overview

- Purpose:
 - Provide information detailing the Digital Lunar Exploration Sites Unreal Simulation Tool(DUST)
- This presentation is:
 - ☐ Decisional
 - ☐ Directional
 - ☒ Informational
 - ☐ Action Item Closure / Status (Provide action number)
- Topics:
 - Introduction and Design Goals
 - Capabilities Overview
 - Lunar Terrain Generation
 - Infusion and Derivative Products
 - Live Demo
 - Questions

Introduction



- Digital Lunar Exploration Sites (DLES)
 - An organized collection of Digital Elevation Models (DEM) provided by NASA's Lunar Reconnaissance Orbiter (LRO) and the Lunar Orbiter Laser Altimeter (LOLA)
 - LOLA DEM data is provided as a raster data file formatted using the Geospatial Data Abstraction Library (GDAL) translator library
 - JSC's Astromaterials Research and Exploration Sciences (ARES) team lead by Sam Lawrence removes instrumentation artifacts from the DEM files
 - Most of the data for the Lunar South Pole (LSP) is captured at 5 meters-per-pixel (mpp) resolution
 - Upscaled DEM files that include sub-pixel surface features (craters) that are representative of the regions of interest that are not captured by the LOLA instrument
- DLES Unreal Simulation Tool (DUST)
 - An integrated framework that provides a digital representation of the physical system in a representative operational environment
 - Built with the Unreal Engine 5 game engine



Design Goals

- Initially conceived as a tool that could quickly visualize the DLES data products in real-time
- Designed to provide a high-fidelity visualization and analysis tool
- Provide date specific lighting
- Support site and mission planning for lunar architecture and Artemis Base Camp analysis
- Distributable to a wide array of computational platforms
 - Windows
 - MacOS
 - Linux





Capabilities Overview

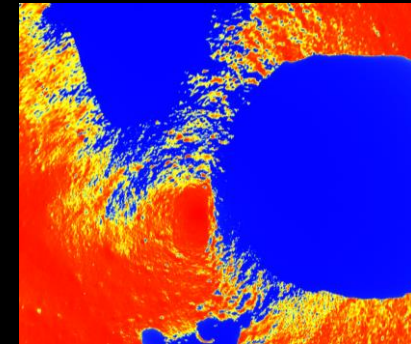
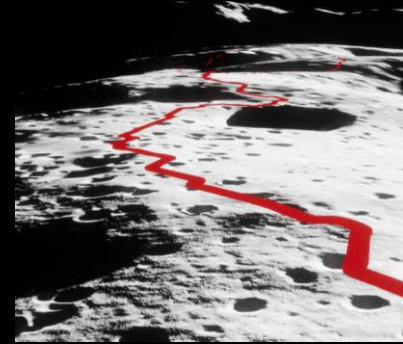
- **SPICE Integration**
 - A toolkit developed by NASA to track the positions and orientations of planetary bodies and spacecraft
 - Provides an API that reads kernel datasets containing information about the tracked objects over a timeframe
 - Provides the Sun and Earth positions and orientations in DUST with respect to the Moon's planet-fixed coordinate frame
- **Trick Integration**
 - A NASA developed open-source simulation environment that provides an architecture for simulation development
 - DUST provides an interface to connect to a Trick simulation over a socket and provide a visualization environment of the physics-based simulation (e.g. rover, lander, etc)
- **Persistent Object Data Base (PODB) Integration**
 - A NASA generated database with a web API wrapper that stores positional data of persistent synthetically added lunar objects such as rocks and craters
 - The DUST PODB integration tool queries the PODB API for rock data in any designated region and allows you to visualize these rock distributions within the tool

Capabilities Overview Cont.



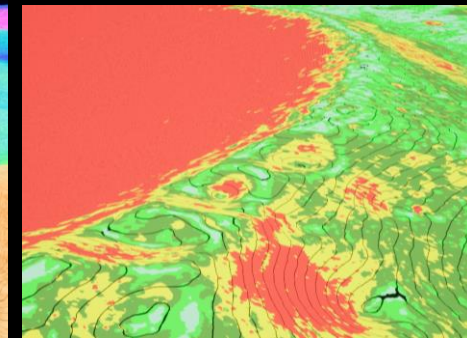
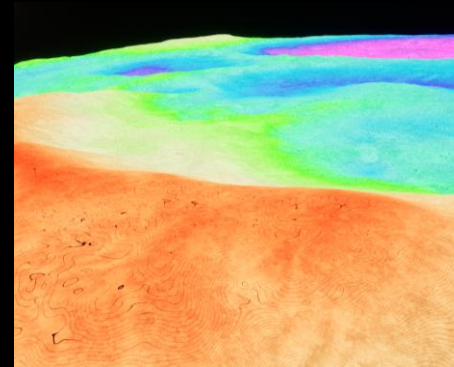
- **Rover Traverse Visualizer**

- DUST can parse rover traverse data and display it on the simulated lunar surface
- Waypoints be edited in real-time and exported
- Visualize a rover following the traverse with respect to time



- **Communication (Line-of-Sight) Visualizer**

- Communication towers can be placed on the surface, and their range and occlusion can be visualized to determine where on the terrain the signal would reach with the specified tower configuration
- Gateway and Earth LoS

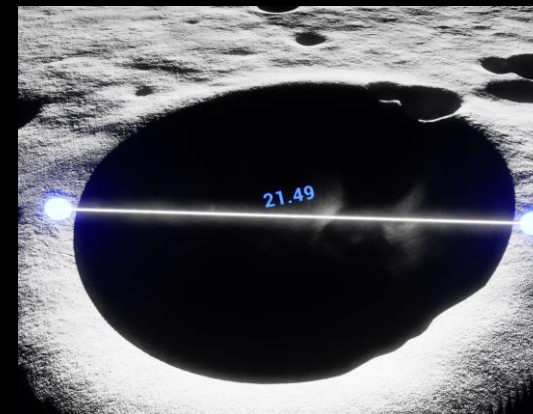


- **Topography Visualizer**

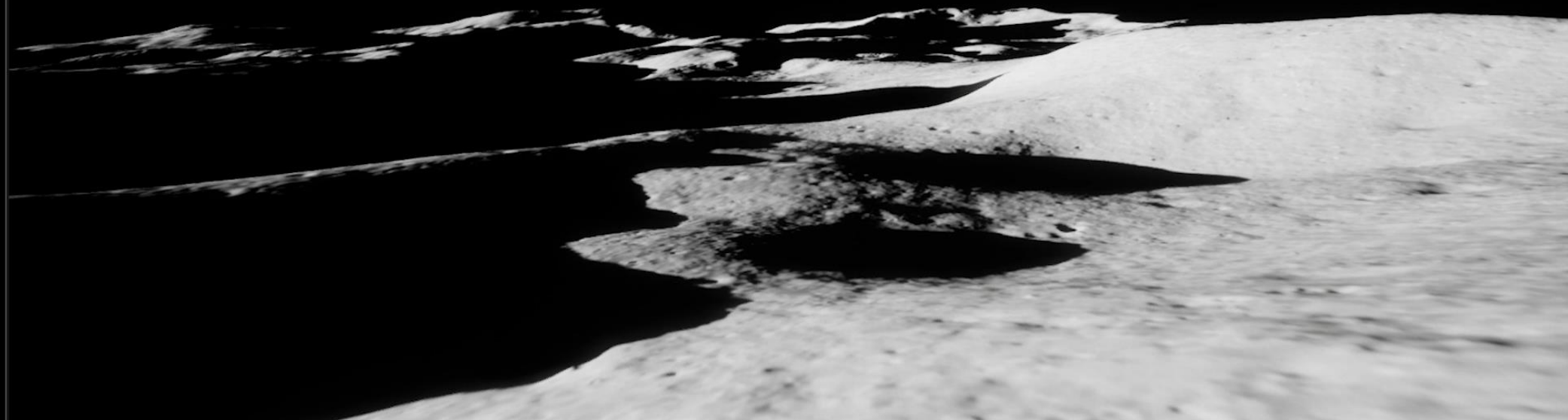
- DUST can generate slope map analysis with contour lines overlaid across all rendered lunar terrain
- Elevation map data can be automatically calculated and displayed in place of slope data

- **Measuring Tool**

- Provides 3D measuring capability in meters between user specified locations

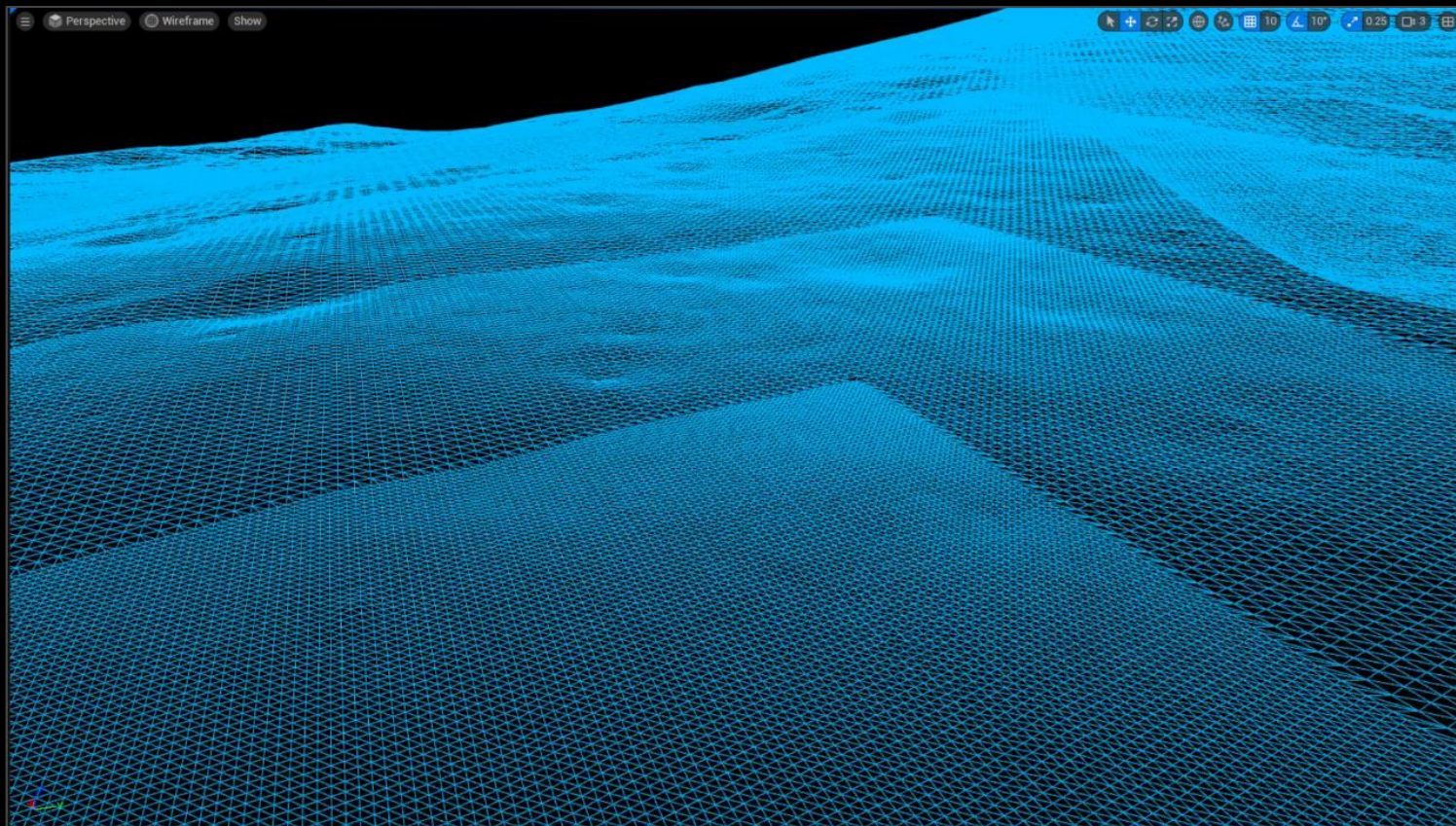


NASA LUNAR TERRAIN



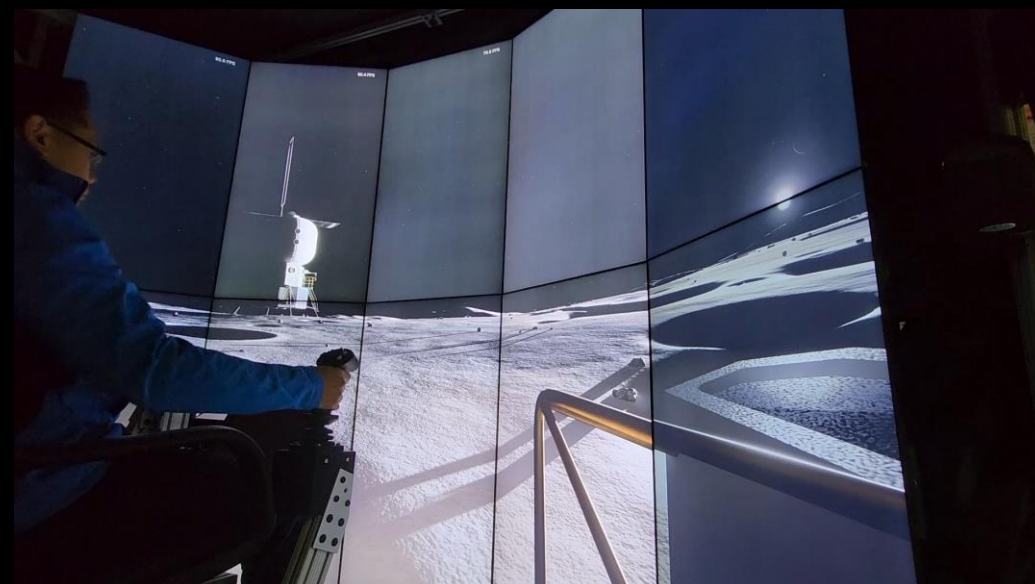
Lunar Terrain Generation

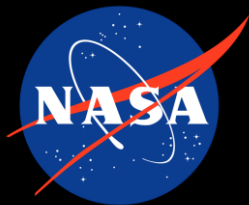
- Clipmap Method:
 - During runtime DEMs are imported and continuously supply the clipmap with data
- Level count, grid width, and starting resolution can be modified in the editor
- During runtime, these settings can be configured with graphics presets
- Lowest level of the grid will continuously follow the viewport's position



Infusion and Derivative Products

- Human-in-the-Loop LTV Lighting and Nav Study Phase 2
 - Derivative product Multi-Unreal Displays (MUD)
 - Video wall implementation of the DUST lunar terrain and Trick simulation integration
- Additional DUST Derivative Products:
 - LURE – Lunar Unreal Replacement for EDGE
 - Bare bones lunar application that will provide the necessary hooks and plugins for visualization of LTV and HLS Lander Trick simulations
 - LUTE – Lunar Unreal Terrain Exporter
 - Application that will can export a polygonal model (Wavefront *.obj) of areas of the Lunar South Pole
 - Allows you to specify a specific area and the resolution of the terrain export model
 - LEE – Lunar ER7 Example Project
 - A distributable Unreal Engine 5 project that utilizes the precompiled binary plugins necessary to render the lunar terrain and connect to a Trick simulation
 - Can be shared with partners (LARC)





Live Demo of DUST



Questions